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Claims

1. (original) An apparatus for applying at least one cyclical load to a specimen, the specimen extending at least along a longitudinal axis, comprising:

a mass;

an actuator mounted to the specimen and operatively associated with said mass, said actuator moving said mass along a linear displacement path that is perpendicular to the longitudinal axis of the specimen; and

a control system operatively associated with said actuator, said control system operating said actuator to reciprocate said mass along the linear displacement path at a reciprocating frequency, said reciprocating frequency being about equal to a resonance frequency of the specimen in a test configuration.

2. (original) The apparatus of claim 1, further comprising a feedback sensor operatively associated with said control system, said feedback sensor producing a feedback signal, said control system being responsive to the feedback signal produced by said feedback sensor, said control system operating said actuator to change a displacement of said mass in response to said feedback signal.

3. (original) The apparatus of claim 2, wherein said feedback sensor comprises a strain gauge and wherein the feedback signal produced by said feedback sensor is related to a strain in the specimen.

4. (original) The apparatus of claim 2, wherein said feedback sensor comprises an accelerometer and wherein the feedback signal produced by said feedback sensor is related to an acceleration of the specimen.

5. (original) The apparatus of claim 1, further comprising a load frame mounted to the specimen, said actuator being mounted to said load frame.

6. (original) The apparatus of claim 5, wherein said actuator comprises a linear hydraulic actuator having a proximal end and a distal end, the proximal end of said linear hydraulic actuator being mounted to said load frame, the distal end of said linear hydraulic actuator being mounted to said mass.

7. (original) The apparatus of claim 1, further comprising a transverse load actuator operatively associated with the specimen, said transverse load actuator applying to the specimen a load in a transverse direction, said transverse direction being substantially orthogonal to the longitudinal axis of the specimen and to the linear displacement path.

8. (original) The apparatus of claim 7, wherein the load applied to the specimen by said transverse load actuator is varied at the reciprocating frequency.

9. (original) The apparatus of claim 1, further comprising a static mass mounted to the specimen.

10. (original) A system for vibrating a specimen, the specimen extending at least along a longitudinal axis, comprising:

reciprocating mass means operatively associated with the specimen for vibrating the specimen along the longitudinal axis at about a resonance frequency of the specimen in a test configuration; and

displacement control means operatively associated with said reciprocating mass means for varying a vibrational displacement of the specimen.

11. (original) The system of claim 10, wherein said reciprocating mass means comprises: a mass; and actuator means operatively associated with said mass

for reciprocating said mass along a displacement path that is perpendicular to the longitudinal axis of the specimen.

12. (original) A method for vibrating a specimen, the specimen extending at least along a longitudinal axis, comprising:

mounting amass to the specimen so that said mass can be reciprocated along a linear displacement path that is perpendicular to the longitudinal axis of the specimen; and

reciprocating the mass along the linear displacement path at a reciprocation frequency that is about equal to a resonance frequency of the specimen in a test configuration.

13. (original) The method of claim 12, further comprising:

detecting a strain in the specimen; and

controlling a displacement of the mass to place a desired load on the specimen based on the detected strain.

14. (original) The method of claim 12, further comprising:

detecting an acceleration of the specimen; and

controlling a displacement of the mass to place a desired load on the specimen based on the detected acceleration.

15. (original) The method of claim 12, further comprising applying to the specimen a load in a transverse direction, the transverse direction being substantially orthogonal to the longitudinal axis of the specimen and to the linear displacement path.

16. (original) The method of claim 15, further comprising varying the load applied to the specimen in the transverse direction at about the reciprocation frequency.

17. (original) An apparatus for applying at least one cyclical load to a specimen, the specimen extending at least along a longitudinal axis, comprising:

a mass;

an actuator mounted to the specimen and operatively associated with said mass, said actuator moving said mass along a linear displacement path that is substantially perpendicular to the longitudinal axis of the specimen;

a transverse load actuator operatively associated with the specimen, said transverse load actuator applying to the specimen a cyclical load in a transverse direction, said transverse direction being substantially perpendicular to the longitudinal axis of the specimen and to the linear displacement path; and

a control system operatively associated with said actuator and said transverse load actuator, said control system operating said actuator to reciprocate said mass along the linear displacement path at a reciprocating frequency, said reciprocating frequency being about equal to a resonance frequency of the specimen in a test configuration, said control system operating said transverse load actuator to vary the cyclical load at about the reciprocating frequency.

18. (original) The apparatus of claim 17, further comprising a feedback sensor operatively associated with said control system, said feedback sensor producing a feedback signal, said control system being responsive to the feedback signal produced by said feedback sensor, said control system operating said actuator to change a displacement of said mass in response to said feedback signal.

19. (original) The apparatus of claim 18, wherein said feedback sensor comprises at least one accelerometer.

20. (original) The apparatus of claim 18, wherein said feedback sensor comprises at least one strain gauge.

21. (original) The apparatus of claim 17, wherein said control system comprises a PID controller.